

## ABSTRACT OF THE DISCLOSURE

A method which coordinates proton beam irradiation with an open magnetic resonance imaging (MRI) unit to achieve near-simultaneous, noninvasive localization and radiotherapy of various cell lines in various anatomic locations. A reference image of the target aids in determining a treatment plan and repositioning the patient within the MRI unit for later treatments. The patient is located within the MRI unit so that the target and the proton beam are coincident. MRI monitors the location of the target. Target irradiation occurs when the target and the proton beam are coincident as indicated by the MRI monitoring. The patient rotates relative to the radiation source. The target again undergoes monitoring and selective irradiation. The rotation and selective irradiation during MRI monitoring repeats according to the treatment plan.